REPRODUCTIVE BIOLOGY OF THE CANADIAN LABIATAE*

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INTRODUCTION

The Canadian Labiatae comprise 68 species belonging to 29 genera. About half of these species have been introduced into North America since European settlement of the continent. Few studies of reproductive biology in the Labiatae have been undertaken. Information on the reproductive biology comes chiefly from some European Floras e.g., Clapham, Tutin and Warburg (1962), Hegi (1964) and from detailed studies of individual genera or small groups of species, e.g., Chambers (1961), on Pycnanthemum. A cyto-taxonomic survey of the West African species has been published by Morton (1962) in which chromosome numbers, reproductive biology, variation and taxonomy are considered. However, no comparable work has been done on the Canadian Labiatae. Hence a survey of pollination mechanisms and compatibility in the Canadian species was considered desirable, particularly in view of the importance of such information in an interpretation of variational pattern and evolutionary mechanisms.

MATERIAL AND METHODS

Living material of all the known Canadian Labiatae was brought into cultivation at Waterloo either by transplanting rootstocks or by raising plants from seeds. Prior to the opening of the flower of each species, the inflorescence, or in most cases, the whole plant, was bagged. The bags were made from Terylene cloth of Imm. square mesh which facilitates the free exchange of air and moisture but prevents the entry of pollinating insects. Normally five to ten plants were bagged,

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but in some cases due to scarcity of material only one to two plants could be used. The bags were left in tact until the last corolla had withered. They were then removed and the seed allowed to mature. For purpose of comparison, unbagged specimens of the same plant were grown alongside the bagged ones and were left to be open-pollinated. Seeds from both bagged and open-pollinated plants were examined under a dissecting microscope. About 50 fruiting calyces were examined in each case and the numbers of well formed and apparently viable seeds were recorded.

RESULTS AND DISCUSSION

Reproductive biology and longevity (i.e., annual or perennial habit) have an important effect on the evolution of plants and on the pattern of variation which develops. Darlington and Mather (1949) state that obligate in-breeding is an evolutionary dead end. The genetic implication of inbreeding on the reproductive system is to promote homozygosity. An example of this is to be found in the rye-grass (Breese, 1966). Two species - Lolium remotum and L. temulentum were at one time common weeds of flax and cereals respectively, and the inbreeding system evolved to match that of their companion crop, giving them high fitness for the arable conditions which they exploited. However, with improved cultural conditions, they have now been virtually eliminated as weeds in these crops, thus paying the penalty for lost variability. Baker (1965) claims that for any taxon to be a successful colonizer, a high frequency of self-compatibility, coupled with an "all purpose gnotype", is the ideal breeding system. However, success as a colonizer does not necessarily imply long term evolutionary success.

The present results from the Canadian Labiatae can be discussed under three categories:

1. Species that are annuals:- The majority of Labiatae are perennials but the family contains a few annuals. All of these are/either weeds of disturbed land or plants of open habitats such as the lime stone pavements. All these annual species are self compatible (Table 1),

(though not necessarily always self pollinated), and most are diploid, Galeopsis tetrahit and Satureja hortensis being the only two exceptions out of the 10 annual species occuring in Canada.

2. Species which are caespitose perennials -

Of the 25 species of caespitose perennials which occur in Canada (Table 2), 18 are self-compatible and able to self pollinate. The remaining seven species either require an outside pollinating agent or are self-incompatible. Most of these caespitose perennials (16 out of 25) are diploid - the incidence of polyploidy being 36%. Stebbins (1965) obtained similar results on a wide range of caespitose perennials from California.

3. Rhizomatous or stoloniferous perennials:-

This group contains 22 species (Table 3). Of these 10 are outbreeders, and one Pycnanthemum virginianum, is apomictic. All the outbreeders have large conspicuous flowers (except in Mentha where the flowers are arranged in tight conspicuous groups) - a character which is frequently associated with outbreeders.

Among the rhizomatous perennial Labiatae, the frequency of polyploidy is 63.6%. Stebbins (1965) obtained 50% polyploidy in the native Californian rhizomatous perennial species belonging to a wide range of families. The percentage of polyploidy in the native perennial Labiatae of Canada is 51.6%. Mulligan (1960) working on Canadian weed flora gives a figure of 46% polyploidy in the weed flora and as a whole 55% polyploidy in the perennial species. He further states that the incidence of polyploidy is nearly the same in both the introduced and native species. This is in line with the present results in Labiatae where 50% of the introduced species are polyploid compared with 51.6% of the native species.

So it is clear from these results on the Canadian Labiatae that they follow the general rules relating to polyploidy, longevity and reproductive biology which apply to most groups of plants. Polyploidy and outbreeders are at a minimum in annuals and highest in rhizomatous perennials. The annuals are normally species which inhabit open environments where competition is at minimum and hence establishment of the plant is not impeded; whereas most of the perennials, particularly the rhizomatous species are plants of closed communities where, once established, they are able to compete successfully by means of their vigorous rootstocks.

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SUMMARY:

Reproductive biology of the Canadian Labiatae has been studied. All the annual species have been found to be self-compatible and mostly diploid. The 18 species of caespitose perennials are self-compatible and seven species are self-incompatible. The incidence of ploidy in caespitose perennials is 36%. From the 22 rhizomatous perennials 10 are outbreeders and one Pycnanthemum virginianum is apomictic. The frequency of ploidy in this group is 63.6%.

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Table 1 Annual Species

Species	Native	Introduced	Reproductive System	Base	Ploidy
Isanthus brachiatus	+		inbreeder	7	2x
Hedeoma hispida	+		inbreeder	19	Dibasic polyploidy
Hedeoma pulegoides	+		inbreeder	19	Dibasic polyploidy
Galeopsis tetrahit		+	inbreeder	8	4x
Lamium amplexicaule		+	inbreeder	9	2x
L. purpureum		+	inbreeder	9	2x
Moldavica parviflora	+		inbreeder	7	2x
Salvia pratense		+	inbreeder	9	2x
Satureja acinos		+	inbreeder	10	2x
S. hortensis		+	inbreeder	8	6x

Table 2 Caespitose perennials

Species	Native	Introduced	Reproductive System	Base	Ploidy
Agastache foeniculum	+		inbreeder	9	2x
A. nepatoides	+		inbreeder	9	2x
A. urticifolia	+		outbreeder	9	2x
Ballota nigra		+	inbreeder	11	2x
Hyssopus officinalis		+	outbreeder	6	2x
Lamium album		+	inbreeder	9	2x
L. maculatum		+	inbreeder	9	2x
Leonurus cardiaca		+	outbreeder	9	2x
Marrubium vulgare		+	inbreeder	17	2x
Melissa officinalis		+	inbreeder	8	4x
M. thymiflora		+	inbreeder	7	2x
Monarda didyma	+		outbreeder	9	4x
M. fistulosa	+		inbreeder	9	4x
M. punctata	+		inbreeder	11	2x
Nepeta cataria		+	inbreeder	x_2=17	4x
Origanum vulgare		+	outbreeder	15	2x
Prunella vulgaris	+		inbreeder	7	4x
Salvia nemorosa		+	outbreeder	7	2x
Satureja glabella	+		inbreeder	10	2x
S. douglasii	+		inbreeder	10	2x
S. vulgaris	+		inbreeder	10	2x
Stachys germanica		+	inbreeder	5	6x
S. olympica		+	inbreeder	5	6x
Thymus serpyllum		+	inbreeder	6	4x
T. pulegoides		+	inbreeder	7	4x

Table 3 Rhizomatous perennials

Species	Native	Introduced	Reproductive Biology	Base	Ploidy
Ajuga reptans		+	outbreeder	8	4x
Collinsonia canadensis	+		inbreeder (partial)	13	4x
Glechoma hederacea		+	outbreeder	9	4x
Lycopus asper	+		inbreeder	11	2x
L. europeus		+	inbreeder	11	2x
L. americanus	+		inbreeder	11	2x
L. rubellus	+		inbreeder	11	2x
L. uniflorus	+		inbreeder	11	2x
Mentha arvensis	+		outbreeder	8	12x
M. spicata		+	outbreeder	6	6x
Physestegia virginiana	+		outbreeder	19	2x
Pycnanthemum tenuifolium	+		inbreeder	10	4x
P. virginianum	+		apomictic	10	8x
Scutellaria galericulata	+		inbreeder	8	4x
S. lateriflora	+		inbreeder	11	4x
S. leorardi	+		inbreeder	10	2x
S. parvula	+		inbreeder	10	2x
Stachys cooleyae	+		outbreeder	17	4x
S. mexicana	+		outbreeder	8	8x
S. tenuifolia	+		outbreeder	8	8x
S. palustris	+		outbreeder	8	8x
Teucrium canadense	+		outbreeder	8	4x